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Erigeron acris, L.
Inula viscosa, Desf.
Xanthium spinosum, L.
Chrysanthellum procumbens, Rich.
Heliotropium Europæum, L.
Anchusa officinalis, L.
Convolvulus arvensis, L.
Solanum nigrum, L., var. *villosum*, Mill.
Verbascum sinuatum, L.
Antirrhinum Orontium, L.
Amarantus deflexus, L.
Amarantus Blitum, L.
Chenopodium album, L., var. *viride*, Moq.
Roubieva multifida, (L.) Moq.
Polygonum hernarioides, Del.
Euphorbia Peplis, L.
Euphorbia Peplus, L.
Euphorbia Terracina, L.
Mercurialis annua, L.
Cyperus rotundus, L.
Cynodon Dactylon, (L.) Pers.

THOS. C. PORTER.

Notes on the Development of Conidia-Bearers in Acrostalagmus, Corda, sp. und.

BY CONWAY MACMILLAN.

(Plate CXXIII.)

On decaying stems of *Dahlia* in the plant-house of the University of Minnesota an interesting fungus belonging to the Hyphomycetes has been observed, sometimes in abundance. It forms tenuous coatings of loosely woven filaments on the *Dahlia* stems, and from these coatings arise delicate, erect, jointed filaments bearing whorls of conidial-branches acropetally arranged, becoming less and less mature as one passes nearer to the tip of the erect filament. These upright hyphæ are about one millimeter in length, and, when abundant, form little forests of conidia-bearers (*conidiaträger*) upon the diaphanous mycelial network, which is closely appressed to the epidermis of the dead *Dahlia* stem.

Under the low magnification of an ordinary Leitz dissecting microscope these tree-like condia-bearers are very distinctly differentiated. The central stouter filament may be detected running from the mycelial cushion to the very end of the conidia-bearer. Along the upper two-thirds it is covered with the close whorls of conidial-branches, arranged for the most part in fours, and becoming briefer and less complicated towards the summit, until, near the apex, they become reduced to slight protuberances barely prominent on the sides of the erect, stout, central filament. The very apex of this central filament is prolonged into a cylindro-conical hypha, so that the whole shape of each conidia-bearer may be roughly compared to the contour of a half-grown tree of *Pinus Strobus*, L., or perhaps even better, to some of the slenderer species of *Araucaria* with their distinctly whorled branches. Examination of a considerable number of plants was made, under powers of from four hundred and fifty to nine hundred diameters, and several different stages in the maturation of the conidia-bearers were noted in detail. An effort was made to trace the complete development of these organs.

The first appearance of the conidia-bearer is as an erect, densely protoplasmic protuberance from a thread of the mycelial cushion. This protuberance increases rapidly in length, retaining throughout its growth a strong zenotropic (apogeotropic) irritability, and a horizontal septum is developed, cutting off a distal, from the basal cell. The distal cell, together with the basal cell, undergoes further elongation, and in the considerably denser contents of the distal cell numerous vacuoles make their appearance, but, in so far as seen, do not attain to any very great size, remaining, on the contrary, about one-quarter the diameter of the cell in which they appear. Synchronously there appear protuberances, at first scarcely perceptible, then rapidly elongating into thread-like projections, upon the wall-area of the distal cell. Originally these protuberances are isodiametrical, but before they equal in length the diameter of the cell producing them a swelling in the free end of the projection is seen to take place. The growth of the branch now continues in such a way that the central filament of the conidia-bearer supports four lateral club-shaped branches, each of which is elongated considerably—perhaps one-fortieth mm. from insertion to apex—and stands very nearly at right angles with the central filament and with the two adjacent sister-branches in the same whorl. Before any whorl has arrived at this stage the next whorl above will be seen to be developing as filamentous outgrowths, or as projections, from the central hypha.

After having assumed the club-shaped appearance just described, the branch-hypha elongates further, becomes distinctly vacuolated and swells somewhat along its whole extent in such a manner that the points of greatest constriction are just at the insertion of the hypha, and just below the club-shaped apex. Further development now takes place in the terminal swollen area of each branch-hypha in such a way that the extreme apex is prolonged into a conical point, and four similar conical projections appear equidistant from each other around the equatorial region of the terminal swollen area. Each of these five projections thus formed continues its growth and behaves much as did the parent branch-hypha. Thus five secondary branch-hyphæ are produced, or four, if we choose to consider the terminal projection as a continuation of the primary branch-hypha. Each of the five projections develops a ternary five-lobed projection, and in rare cases each ternary lobe may develop a series of five quaternary lobes. In the formation of secondary, ternary and quaternary lobes or branches the whorled arrangement is not original, but is the result of post-developmental compression, differing from the formation of the primary branch-hyphæ. In this latter case alone did the whorl seem to be a true whorl. The development of ternary lobes is usually not followed by the elongation and differentiation of each lobe into a hypha and quaternary-lobe-series. This was noted in but one conidia-bearer among over two hundred.

The ternary lobes (or quaternary in cases where they occur) are the conidial areas. The process of forming the conidia is as follows:

Each lobe becomes swollen into a more or less spherical shape, and the greater part of the convex surface becomes at first faintly rugose. Later it is seen to be covered with small hemispherical buds. These buds undergo basal constriction and become more or less distinctly obovoid in appearance. The buds, which are destined to become the conidia, do not extend into the concavities of the lobe-system or into the interlobal areas of the secondary branch-hyphæ. They remain thickly aggregated upon the convexities. They develop more rapidly upon the lateral ternary lobes, and more slowly upon the terminal ternary lobes. Likewise the development is, as a whole, more rapid upon the lateral secondary branch-hyphæ than upon the terminal. These facts are strictly in accord with the acropetal development of the whole conidia-bearer.

Each conidial area, at first simply regose from the crowded projections on its surface, gradually becomes clothed with the oborate buds which grow and become abstricted into fusiform or somewhat acutely ovate conidia, $6\text{-}7 = 2\frac{1}{2}\text{-}3\frac{1}{2}\ \mu\mu$ in diameter. In a single conidia-bearer one may see all the gradations in the branch whorls, from the mere projecting warts towards the apex to the ternary or quaternary lobed branches near the base. In all cases examined the basal third of the central filament does not become clothed with primary branch-hyphæ, but remains unbranched, septate, thick-walled, as a supporting trunk.

Examination of mature conidial-branches shows an increase in the size of the vacuoles until in the branch which has completed the abstriction of its conidia we find only traces of protoplasm in the hyphæ and lobes, the greater portion being occupied by the enlarged coalescent vacuoles.

No septæ have been observed in any part of the conidia-bearer except in the central filament. Here, too, they are principally confined to infraconidial areas, and occur very rarely between successive whorls of primary branch-hyphæ. This fact, taken in connection with the great enlargement of vacuoles in mature conidial-branches, may be considered as a physiological adaptation by which the transfusion of protoplasmic substances into the distally situated conidia is always easily brought about, there being no membranes in the way to compel dialysis.

The whole plant is hyaline or whitish, and would seem to be quite certainly in the genus *Acrostalagmus*, Corda, although the mucilage layer surrounding the conidia—distinguished by Berlese, thus correcting the older view of a capsular wall—was not satisfactorily demonstrated. It certainly is not *Botryosporium*, which is the only genus of Hyphomycetes mentioned by Farlow and Seymour as occurring on North American plants of *Dahlia variabilis*, Desf. The conidia themselves were carefully studied, and a few cultnre experiments were made with negative results.

The conidia are mediumly thick-walled, hyaline. The cells of the central filament, in the infraconidial portion, were, in specimens measured, from 10 to 18 μ in diameter, and from 10 to 40 μ in length. The cell contents in the infraconidial portion were pretty free from granular substances, and were in some cases slightly refringent; but in the conidial portion the cell contents became decidedly granular. This granulousness was most marked in the terminal area of the central filament, where, too, glycogen-tests revealed an abundance of this substance.

Very good diagrammatic representations of *Acrostalagmus* conidia-bearers is given in Fig. 3 on p. 37 of Zopf's Die Pilze, but this considers only a simple case where the branching is not even secondary, to say nothing of ternary or quaternary. Fig. 3, p. 42, of the same work gives a rather better idea of the more complicated forms, such as have been described above.

DESCRIPTION OF PLATE CXXIII.

Figures illustrating the development of conidia-bearers in *Acrostalagmus*, Corda, *sp. und.* All were drawn under Leitz obj. 7, 9 and $\frac{1}{12}$ with the Abbe Camera, from specimens cultivated on stems of *Dahlia variabilis*, Desf, in the plant-house of the University of Minnesota, May, 1891.

Fig. 1.—Tip of central filament, showing mode of origin of primary branch-hyphæ in whorls of fours.

Fig. 2.—Young branch-hypha.

Fig. 3.—Older branch-hypha, showing origin of secondary branch-hyphæ.

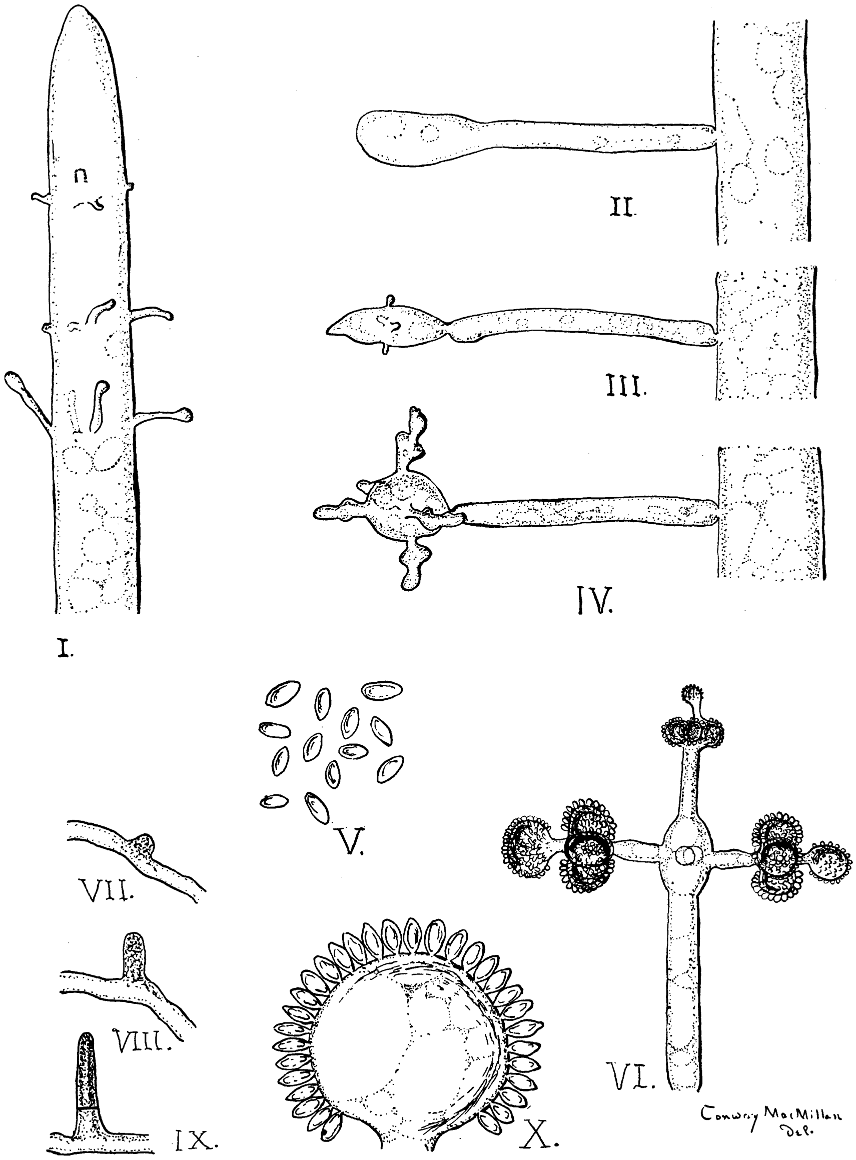
Fig. 4.—Still older branch-hypha, showing secondary hyphæ more fully developed and producing the temary lobes.

Fig. 5.—Conidia, abstricted and showing fusiform or sharply ovate shape.

Fig. 6.—Branch-hypha, showing developed secondary hyphæ and ternary lobes, some of which are bearing immature conidia. Illustrates also the acropetal succession of conidia.

Figs. 7, 8, 9.—The first appearance of the conidiophore and the segmentation of the primitive bud.

Fig. 10.—A single conidial lobe showing method of conidial abstriction. (Optical section).



CONIDIA–BEARERS IN ACROSTALAGMUS. Conway MacMillan.